DOCUMENT RESUME

ED 436 852 EA 030 183

AUTHOR	Ediger, Marlow
TITLE	Role of the Principal in the Science Curriculum.
PUB DATE	1999-00-00
NOTE	11p.
PUB TYPE	Opinion Papers (120)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Change Strategies; Educational Administration; *Educational Change; *Educational Improvement; Elementary Secondary Education; *Instructional Leadership; Principals; Science Curriculum; *Science Instruction

ABSTRACT

This paper discusses how a quality program of science instruction can be developed and achieved. It emphasizes the principal's vital role in improving the science curriculum, claiming that principals should work with teachers to develop a high-quality set of objectives, learning opportunities, and evaluation techniques to modify the curriculum. The report outlines educational objectives and how each objective should be relevant and vital for pupil attainment. Three kinds of objectives need to be established: knowledge, skills, and attitudinal ends. The scope and sequence of science units is described as the paper advocates narrowing the scope to accommodate the lack of time and the lack of teaching materials. When teaching science, the sequence of instruction should be scrutinized, teachers and principals must develop valid criteria to use in the selection of learning opportunities. Students need to have ample opportunities to identify relevant problem areas to facilitate their problem-solving skills. Educators should determine valid and reliable means of appraising pupil progress, which might entail the use of standardized tests and portfolios. Results from evaluations can then be used to improve instruction. Finally, teachers and principals need to study and analyze trends when developing a science curriculum. (RJM)

Reproductions supplied by EDRS are the best that can be made
from the original document.

ED 436 852

ROLE OF THE PRINCIPAL IN THE SCIENCE CURRICULUM

Ediger, Marlow

EA 030 183

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

- [x] This document has been reproduced as received from the person or organization originating it.
- [ ] Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY

M. Ediger

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

ERIC BEST COPY AVAILABLE

ROLE OF THE PRINCIPAL IN THE SCIENCE CURRICULUM

Ediger, Marlow

The principal has a vital role to play in improving the science curriculum. Too frequently, teachers are left on their own in improving the science curriculum. Certainly, the principal of the school also needs to take much interest in seeing that the best science curriculum possible is in the offing. Pupils need to achieve as optimally as possible in the world of science. New ideas, philosophies, and technologies are with us in the scientific arena. It behooves the principal and teachers to work together in developing a high quality set of objectives, learning opportunities, and evaluation techniques to modify/change the curriculum from what is to what should be.

Objectives in Science for Pupil Achievement

Which objectives should pupils achieve in ongoing science lessons and units of study? Each objectives needs to be relevant and vital for pupil attainment. Outdated objectives and trivia need to be discarded. Teachers and principals periodically need to review present objectives and study what is current and needs to be adopted. An updated science curriculum should then be in the offing. It takes time and effort to update the objectives, learning opportunities, and appraisal sections for learner attainment. However, much time can be saved by leaning upon research, objectives that have been developed by other school systems, national and state organizations in the teaching of science, as well state department produced curriculum guides. When using these diverse sources, teachers and principals need to synthesize efforts by coming up with a quality set of objectives for pupils to achieve.

Three kinds of objectives need to be established for learner achievement. One category of objectives pertains to the knowledge category. Knowledge here stresses important facts, concepts, and generalizations that pupils should achieve. Thus, for example in a unit on "The Changing Surface of the Earth," teachers and principals have chosen the following concepts for pupils to attach meaning to in terms of knowledge objectives:

1. lava, magma, volcanic eruptions, as well as igneous, metamorphic, and sedimentary rocks.
2. sheet and gully erosion.
3. wind and water, as change agents on the surface of the earth.
4. folding, faulting, and earthquakes.
5. glaciers and glaciation.

Each concept may then be stated as an objective for pupils to achieve. Item number one, listed above, might then be written in the following manner as an objective: the pupil will tell orally and/or in

EA 030 183

BEST COPY AVAILABLE

writing how igneous, sedimentary, and metamorphic rock are formed. Learning opportunities need to be in the offing so that pupils might attain this objective.

In addition to knowledge objectives, pupils also need to achieve skills ends. Skills stress pupils using knowledge that has been acquired. Knowledge then has utilitarian and practical values. The following are vital skills objectives for pupil attainment:

1. identify relevant problems in ongoing units of study. A vital problem, among others, includes, "Why do volcanic eruptions occur?"
2. gathering and organizing information in response to the identified problem. A variety of activities and experiences are necessary in the data gathering arena.
3. developing an hypothesis in answer to the identified problem. The hypothesis is tentative and subject to testing.
4. thinking critically about how to test the tentative hypothesis. Critical thinking is also needed when separating the relevant from the irrelevant, the vital from that which is not vital in gathering data to test the hypothesis.
5. thinking creatively in order to use in unique ways means of information gathering and hypothesis testing. Pupils need to be creative in problem solving as a means of using knowledge (Ediger, 1999, 27-32).

Skills objective then are salient for pupil attainment. Pupils do not learn knowledge for its own sake but rather to put it to use. Each skills objective needs to be weighed in terms of importance and selected based on careful deliberation.

A third kind of science objective for pupil attainment is attitudinal ends. Quality attitudes are valuable for pupils to develop. Why? If pupils have good attitudes toward learning science, then knowledge and skills objectives should be achieved more readily. Poor attitudes hinder learner achievement and progress. Which attitudinal ends are relevant for pupil achievement? The following are quality attitudes for learner attainment:

1. <u>wanting</u> to learn in ongoing lessons and units of study.
2. desiring to achieve optimally in ongoing lessons and units of study.
3. having intrinsic motivation to achieve, learn, and grow in the science curriculum.
4. helping others to achieve within a committee and collaborative setting.
5. being responsible for one's own learning and progress in science (Ediger, 1999, 13-19).

ERIC

Scope and Sequence in Science

The scope of the science unit states how broad the subject matter will be in content for pupils to achieve. Teachers and principals may delimit the unit with the scope being narrower in content to be studied. Thus, selected concepts might be eliminated that were originally chosen. Why narrow the scope of the science unit? The following are valid reasons:

1. the time factor. There are other science units that also need to be taught.
2. a lack of teaching materials. Adequate materials of instruction need to be available so that depth learning for pupils might be in evidence.
3. the unit will already receive adequate attention. There needs to be rational balance among the different science units to be taught. Extending the science unit may curtail the study of other relevant units.

If the scope of the unit being considered is too narrow and needs to be broadened, the following might well be appropriate reasons:

1. the unit as it presently is would not guide pupils to understand the subject matter adequately since too many vital concepts are not being considered in teaching and learning.
2. the unit being considered needs to be increasingly related to other science units. Certain concepts then need to be reviewed and incorporated into the present science unit. Broadening the scope will incorporate review and interrelationships among the diverse science units to be taught.
3. more depth teaching needs to be stressed, increasing the number of objectives and subobjectives for pupils to attain.

Sequence in science emphasizes which order the objectives are to be achieved by learners. Quality order of objectives stressed in teaching makes it so that previously attained objectives provide background information or readiness for the ensuing ends stressed in teaching and learning. Poor sequence may make it so that the objectives are too complex for learner attainment. Failure to learn may be an end result. If the ends are too easy, boredom and routiness may be felt by involved pupils. It behooves the teacher to provide objectives in science that are attainable and yet challenging. Careful attention needs to be placed upon objectives being sequential for learners to achieve so that new objectives have readiness factors taken care of and success in learning is an end result (Ediger, 2000, Chapter Three).

Learning Opportunities to Achieve Objectives

Teachers and principals need to develop valid criteria to use in the selection of learning opportunities which guide in achieving chosen ends. The leaning opportunities need to

1. provide for individual differences so that slow, average, and fast learners may attain and achieve as much as possible. No pupil should fall through the cracks and fail. Each pupil needs to be guided to be successful through learning opportunities which guide in achieving desired ends.
2. be varied to meet the diverse learning styles and intelligences (Gardner, 1993) possessed by individual learners.Pupils differ from each other in many ways such as interests possessed, purposes in learning, and abilities.
3. capture pupil attention to secure needed knowledge and skills. Quality attitudes should be an end result.
4. stress individual tasks as well as committee endeavors. Rational balance then needs to be in evidence between the individual and the group in terms of learning opportunities.
5. emphasize a balance between a logical sequence (teacher determined) as well as a psychological sequence (heavy pupil input into science curriculum development).
6. inculcate intrinsic motivation procedures of instruction. Where necessary, the teacher may stress extrinsic motivation, such as prizes and awards for achievement of objectives.
7. meet psychological needs of learners such as belonging and esteem needs. Pupils then need to feel wanted and prized for their accomplishments.
8. recognize talents possessed by individual learners as well as of the group.
9. advocate development of higher levels of cognition (mental development) as well as psychomotor (use of finer and gross muscles) and affective goals (positive feelings).
10. integrate subject matter content as well as emphasize separate subject approaches.

Specific kinds of learning opportunities in science might well include the following: experiments and demonstrations, reading, writing, discussions, reports, project methods, individual work, collaborative endeavors, listening activities such as use of cassettes, use of AV materials, and dramatic experiences.

Problem Solving in Science

Pupils need to have ample opportunities to identify relevant

ERIC

problem areas in ongoing lessons and units of study. These problems need to be clearly stated and vital for solving. Pupils and the teacher should work cooperatively in problem solving activities in the science curriculum. Once a problem has been selected, learners may work individually or collectively to gather necessary information. Information sources need to be on the understanding level of pupils so that success in learning is inherent. Critical thinking is necessary to appraise that which truly reflects upon the problem and that which is less salient. Critical thought may also zero in on detecting bias, the subjective as compared to the objective, band wagon approaches, and a hurried approach in securing knowledge in problem solving. Problem solving takes time and each facet needs adequate deliberation in order to obtain the best information possible to solve an identified problem. The chosen information to solve the problem results in an hypothesis. The hypothesis is tentative and needs testing in a lifelike situation. Data gathering through experiments and demonstration, reading, discussions, resource personnel assistance, and other procedures may assist in testing the stated hypothesis. The hypothesis, as a result, may stand as is, be modified, or rejected in whole or in part.

Pupils need to have ample opportunities to solve problems in science; this skill might well be the heart of science. Experiments and demonstrations are two vital kinds of learning opportunities in the science curriculum. There are many problems that need solving n science and problem solving, as a method, can be used in all facets of life's endeavors where problems exist (See Project 2061, 1989).

Evaluation and Science Achievement

Teachers and principals need to determine valid and reliable means of appraising pupil progress in science. It is necessary to ascertain how well pupils are achieving in ongoing lessons and units of study. Traditional means of appraising pupil progress in science have been the following teacher devised approaches:

1. multiple choice and true-false test items.
2. matching and completion test items.
3. essay and short answer procedures.

Statewide and district level testing has stressed using norm referenced tests, also called standardized tests. These tests have faced considerable criticism due to not having objectives that go along with the test items. With no objectives, the teacher is at a loss as to what to teach. With no objects as benchmarks, the test lacks validity since the test items do not reflect upon what has been taught. it also fails to focus upon what learners have had opportunities to learn.

Criterion referenced tests, generally developed on the state level,

ERIC

have objectives that relate to the items on the test. However, the criterion referenced, as well the norm referenced test, are given so infrequently, usually once a year or less. During the school year, pupils, however, have had opportunities to learn many things, in addition to what appears on a criterion referenced test.

To remedy some of thee weaknesses, portfolios have come into being. The portfolio has considerable input from pupils, whereas in norm and criterion referenced tests, there is zero pupil input into their development and use. Pupils with teacher guidance may then plan what goes into a portfolio. The portfolio emphasizes what has been stressed in terms of objectives for learner attainment. The following items might then become a part of the science portfolio for a pupil:

1. journal writing, diary entries, logs, reports, and other salient written work which pertains to ongoing science units of study.
2. construction work such as solar units made as a part of a unit of study.
3. art work such as bulletin board displays, collages, drawings, designs, pencil sketching, and water coloring on diverse facets of science learning.
4. video tapes on performing science experiments, doing demonstrations, being involved in committee work, participating in discussions, and interacting with others in the classroom setting.
5. cassette recordings of the involved pupil's work in giving oral book reports, peer teaching, collaborative endeavors, and other oral communication work.

The portfolio should not be

1. too voluminous.
2. repetitious.
3. unrelated to objectives in the science curriculum.
4. unrepresentative of the involved pupil's work in the classroom setting and in unit teaching in science.
5. partial to one objective in unit teaching, but rather should encompass the entire set of emphasized science objectives in the curriculum.

Portfolio content should be evaluated by competent people to indicate progress, or lack thereof, of the pupil. The results of the evaluation should provide data on how well each pupil is achieving vital objectives in science. A carefully thought through rubric may be used to appraise the portfolio. A variety of products and processes pertaining to what pupils have learned individually and collectively should be in the portfolio as well as being inherent in all evaluation that pertains to pupil achievement and progress. Feedback from evaluation should make for improved instruction.

Using Evaluation Results to Improve Instruction

Results from the the evaluation process should not gather dust on the shelves, but rather be used for improving teaching and learning in science. For example, teacher observation is used almost continuously in ongoing lessons and units of study in science. Results from observing pupils performing science experiments may be used to

1. help pupils stay on task.
2. identify problems clearly and meaningfully.
3. acquire necessary information effectively and in a relevant manner.
4. use science equipment to stimulate thinking in selection of problems areas as well as in testing hypotheses.
5. test each hypothesis as to its accuracy.

Teacher observation used in context can wisely be used to guide pupils to improve in science learning.

Too frequently in standardized testing as well as in state wide criterion referenced testing, pupils take the test and the only results available from learners having taken the test is the percentile ranking or standard deviation. This just does not tell the teacher much if anything abut helping the pupil to learn and achieve. If feedback were available, the teacher would know what specifically the pupil needs as to learning opportunities to develop sequentially.

Issues in evaluating pupils achievement then are the following:

1. rational balance among teacher developed and standardized/criterion referenced tests.
2. subjectivity in evaluation versus more objective approaches in appraising learner progress.
3. constructivism versus measurement to ascertain pupil achievement.
4. numerical results from pupils such as percentiles and standard deviations versus more general statements made pertaining to learner achievement.
5. pupil versus teacher determination of pupil progress (Ediger and Rao (1996), Chapter Five.

Issues in Science Curriculum Development

Teachers and principals need to study and analyze diverse trends in developing the science curriculum. Which are salient trends to implement? There are no absolutes here. Rather, teachers and principals need to study and implement that which assists pupils to achieve as optimally as possible. The following are issues in curriculum development to study and analyze with the intent of providing the best science curriculum possible for pupils:

1. should subject matter predominate in teaching or should skills have a greater emphasis?

2. should a separate subjects curriculum be stressed or should there be more of an integrated science plan of instruction?

3. should there be rational balance among each of the separate science disciplines to be taught (earth, physical, biological, and chemical) or should one of these be stressed more than the others.?

4. should there be predominately collaborative learning activities for pupils (Vygotsky, 1978) or should there be rational balance in stressing individual endeavors also for learners?

5. should a teacher determined science curriculum be in evidence or should ample time be given to teacher/pupil planning of the curriculum?

6. should the teacher sequence the learning activities for pupils or should the pupil be heavily involved in sequencing his/her own experiences?

7. should the state or school district determine objectives for pupil achievement or should these be selected more so in the local classroom setting?

8. should pupils be taught to do well on tests, such as state and norm referenced tests as well as on TIMSS, or are there there better objectives for pupil attainment?

9. Should an entirely new science program, such as a commercially developed program, be brought in for implementation through inservice education for teachers, or should the science curriculum be developed on the local level, especially the school and classroom levels of instruction?

10. should parents be heavily involved in deciding upon objectives of science instruction? (See National Science Educational Standards, 1997).

Conclusion

How should a quality program of science instruction be developed and achieved? How can each pupil achieve as optimally as possible in science? Pupils deserve the best objectives in teaching and learning. They deserve quality learning opportunities to achieve the chosen ends of instruction. Evaluation should be done in terms of pupils having achieved the carefully determined objectives. Pupils deserve nothing but the best in science instruction. Every educator needs to work in this direction. Parents, too, need to be involved in helping pupils achieve optimally in the science curriculum!

References

Ediger, Marlow (1999), "Improving the Teaching of Science," School Science, 37 (2), 27-32.

Ediger, Marlow (1999), "Portfolios, Science, Pupils, and the Teacher," PSTA Exchange, 22 (3), 13-19.

Ediger, Marlow (2000), Teaching Science in the Elementary School, Second Edition. Kirksville, Missouri: Simpson Publishing Company, Chapter Three.

Ediger, Marlow, and D.B.Rao (1996), Science Curriculum. New Delhi: Discovery Publishing House, Chapter Five.

Gardner, Howard (1993), Multiple Intelligences: Theory into Practice. New York: Basic Books.

National Science Educational Standards (1997). Arlington, Virginia: National Science Teachers Association.

Project 2061 (1989), Washington, DC: American Association for the Advancement of Science.

Vygotsky, L. S. (1978), Mind in Society, Cambridge, Massachusetts: Harvard University Press.

EA 030183

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)

ERIC®

REPRODUCTION RELEASE

(Specific Document)

I. DOCUMENT IDENTIFICATION:

Title: Role of the Principal in the Science Curriculum

Author(s): Marlow Ediger

Corporate Source:

Publication Date: 11-2-99

II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, *Resources in Education* (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic media, and sold through the ERIC Document Reproduction Service (EDRS). Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce and disseminate the identified document, please CHECK ONE of the following three options and sign at the bottom of the page.

The sample sticker shown below will be affixed to all Level 1 documents	The sample sticker shown below will be affixed to all Level 2A documents	The sample sticker shown below will be affixed to all Level 2B documents
PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY Sample TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) 1	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE, AND IN ELECTRONIC MEDIA FOR ERIC COLLECTION SUBSCRIBERS ONLY, HAS BEEN GRANTED BY Sample TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) 2A	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY Sample TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) 2B
Level 1	Level 2A	Level 2B
[X]	[ ]	[ ]
Check here for Level 1 release, permitting reproduction and dissemination in microfiche or other ERIC archival media (e.g., electronic) *and* paper copy.	Check here for Level 2A release, permitting reproduction and dissemination in microfiche and in electronic media for ERIC archival collection subscribers only	Check here for Level 2B release, permitting reproduction and dissemination in microfiche only

Documents will be processed as indicated provided reproduction quality permits.
If permission to reproduce is granted, but no box is checked, documents will be processed at Level 1.

I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce and disseminate this document as indicated above. Reproduction from the ERIC microfiche or electronic media by persons other than ERIC employees and its system contractors requires permission from the copyright holder. Exception is made for non-profit reproduction by libraries and other service agencies to satisfy information needs of educators in response to discrete inquiries.

Sign here,→ please

Signature: Marlow Ediger

Printed Name/Position/Title: Marlow Ediger, Prof.

Organization/Address: DR. MARLOW EDIGER
TRUMAN STATE UNIVERSITY
RT. 2 BOX 38
KIRKSVILLE, MO 63501

Telephone: 660-665-2342 FAX: 660-627-7363

E-Mail Address: Date:

ERIC

(over)